

# SALINE GROUNDWATER AND WASTELANDS FOR PLANT PRODUCTION (INT/5/144)

## D1 New

### MODEL PROJECT

#### CORE FINANCING

YEAR	Experts		Group Activity	Equipment	Fellowships		Scientific Visits		Group Training	Sub-Contracts	Misc. Comp.	TOTAL
	m/d	US \$	US \$	US \$	m/d	US \$	m/d	US \$	US \$	US \$	US \$	US \$
1997	25/0	330,000	82,000	200,000	40/0	126,000	3/0	28,800	168,600	60,000	0	995,400
1998	20/0	279,000	16,000	120,000	0/0	0	6/0	61,200	36,200	48,000	0	560,400
1999	18/0	264,600	0	60,000	0/0	0	3/0	32,400	0	20,000	0	377,000

#### FOOTNOTE a/ FINANCING

YEAR	Experts		Group Activity	Equipment	Fellowships		Scientific Visits		Group Training	Sub-Contracts	Misc. Comp.	TOTAL
	m/d	US \$	US \$	US \$	m/d	US \$	m/d	US \$	US \$	US \$	US \$	US \$
1998	2/0	29,400	16,000	60,000	12/0	39,600	0/0	0	72,400	30,000	0	247,400
1999	6/0	92,700	84,000	50,000	8/0	27,600	0/0	0	0	50,000	0	304,300

First Year Approved: 1997

**OBJECTIVES:** This project deals with the development objective of increasing agri- and silvicultural output by bringing salt-affected barren lands into production using saline groundwater and salt-tolerant plants. It is among the first examples of a new approach to establishing partnerships for development; the interregional Model Project. The immediate objective of the project is to demonstrate techniques for the sustainable use of salt-affected lands at experimental sites in eight countries in the northern sub-tropical region. Several applications are possible, depending on local conditions and need. These range from maintenance of green cover to biomass production for forage, fuel, or agro-industry feed stocks.

**BACKGROUND:** Soil salinity is a worldwide phenomenon. It is generally most serious in arid and semi-arid regions, where surface water is often scarce or unreliable and groundwater also tends to be saline. Soil salinity is a multidimensional problem, having wide macro- and microscale social, economic, and environmental implications. Its causes are manifold, sometimes overlapping. They include natural soil factors, denudation of ground cover, and mismanagement of irrigation. Anthropogenic factors are responsible for saline conditions on about 77 million hectares globally, of which about 45 million hectares are in irrigated areas. Schemes to reclaim salt-affected land in irrigated areas traditionally depend on leaching salts from surface soils with fresh water into sub-surface drainage systems. Reuse of the saline leachate is rare. Despite very large investments by national and international authorities, such reclamation efforts cover only a fraction of the affected soils, leaving large tracts saline (70% of irrigated lands in Iraq and Pakistan, 50% in Syria, 33% in Egypt, and 15% in Iran). In addition there are 32 million hectares of degraded but non-irrigated land, and large tracts that are barren due to naturally occurring soil salinity. In many of these situations, saline groundwater of varying quality is available at shallow depths, making low-cost pumping feasible. However, this groundwater constitutes a useable resource only when coupled with the cultivation of salt-resistant plants. Fortunately, plants have vast genetic variability. More than one hundred species exhibit some native salt tolerance. A selection of mutants with enhanced salt-tolerance, as well as other desirable characteristics, follows from cultivating them under saline conditions. In addition, genetic engineering techniques offer the possibility of introducing genes for salt-tolerance into normal crops. Earlier CRP and national TC projects both led to the conclusion that the overall approach --- selection and cultivation of salt-tolerant plants on saline lands irrigated with saline groundwater --- was sound. Using nuclear techniques, a Member State conducted field demonstrations that verified both its technical and economic feasibility. What needs to be established now are the conditions under which long term sustainability can be achieved, and in this effort, nuclear techniques will play an important role. For example, irrigation with saline water requires careful management, a task that the neutron moisture probe makes much easier. Once plantings are established, plant-soil-water interactions come under scrutiny. Critical parameters include soil texture and permeability; organic carbon storage and degradation; interspecies competition for soil moisture; and evapotranspiration rates. Nuclear and related techniques facilitate their study. Finally, isotope hydrology is crucial to an assessment of the sustainable utilization rate of the water resource. A concept paper outlining an overall strategy attracted the interest of eight countries in Asia, West Asia, and Africa. Subsequent expert missions to all of them, followed by a consultants meeting, led to recommendations and guidelines for the initiation of an Interregional Project.

**PROJECT PLAN:** The project is inherently cross-disciplinary, focusing on demonstrating economic utilization of salt-affected barren land using saline groundwater and salt-tolerant plants chosen to meet local needs. Nuclear techniques will aid in managing irrigation, establishing optimum agronomic practices, and assessing sustainability

of water resources. The six-year plan involves two overall phases, although detailed workplans will be specific to each country and location. Activities in the first phase will include (i) selection and characterization of demonstration sites according to agreed criteria; (ii) collection of basic physical, chemical, isotopic, and environmental data; (iii) selection and initial cultivation of salt-tolerant species tailored to local economic opportunities; (iv) water management with a neutron moisture probe; (iv) determination of water requirements for various species, and their comparative survival and growth; and (v) monitoring of soil and water parameters by means of chemical and isotopic analyses. In the later stages, assessment of the extent of user interest may lead to modifications in the choice of target plants. The outputs from the first phase will consist of well established 10 ha demonstration plots, characterized with regard to data on water management options, basic chemical and physical conditions, yields, and water and soil quality parameters. In the second phase, the previous tasks will continue to completion, augmented by additional activities: (i) isotopic studies to demonstrate the effects of various plants on soil biogeochemistry; (ii) introduction of grazing livestock; (iii) feasibility assessments of using the biomass produced as forage, timber and fuel, or for agro-industrial processing; and (iv) isotope hydrological characterization of the sustainability of the water resource. A desirable capstone activity would be the integrated appraisal of the potential economic, social, and environmental impact of applying the project's findings on a much wider scale. Outputs from this second phase will include detailed information on soil/plant interactions; data on acceptability and nutritional quality of fodder crops for grazing animals; estimates of sustainable water usage; and economic feasibility studies of large scale production of biomass for various purposes.

**NATIONAL COMMITMENT:** Execution of the project is in the hands of the eight participating countries. Each will provide (i) trained personnel; (ii) a suitable experimental site of at least 10 ha of barren salt-affected land, including (iii) arrangements for irrigating it with saline groundwater; and (iv) the necessary infrastructure, such as power, implements, and buildings. The participants have agreed to take responsibility for the implementation of the project by appointing qualified investigators, and for its sustainability by pledging to co-ordinate dissemination of the results to end users.

**AGENCY INPUT:** The Agency will provide expert services, technical advice and backstopping, and a small amount of equipment. It will also arrange group training and scientific visits. Agency support for workshops among the principal investigators will create opportunities for planning, discussion of interim results, and co-ordination among countries. Provisions for subcontracts will strengthen TCDC and put more of the work in the hands of those countries with pre-existing programs. The Agency will strongly encourage the formulation of project activities designed to lead to rapid, large-scale extension of biosaline agriculture in the participating countries. To further this aim, it will also emphasize the importance of the broadest possible dissemination of the results in national, regional, and international forums.

**PROJECT IMPACT:** The potential impact of the project is very large, but realizing that potential will depend on the extent to which the results reach not only farmers, but policy-makers as well. Major macro- and microlevel effects could flow from demonstrations of the possibilities of raising plants on otherwise abandoned lands using saline waters. Even simply establishing ground cover produces benefits including decreased soil erosion, ecological diversification, and overall environmental improvement. Biomass production for fuel, forage for livestock, food, green manure, etc., lead to economic uses of otherwise unproductive land and wasted water resources. Recent studies of global water resources paint an alarming picture for the next century. Humanity now uses 26% of total terrestrial evapotranspiration, and 54% of accessible runoff. Increased use of evapotranspiration will confer minimal benefits globally because most land suitable for rain-fed agriculture is already under cultivation. New dam construction could increase accessible runoff by about 10% in the next 30 years, whereas population is projected to increase by more than 45% during that period. These considerations create a context that highlights the growing importance of biosaline agriculture, which seems likely to increase in the next few decades.